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FIRE-MARK — A COMMON DEFECT IN INDIAN GOAT AND SHEEP SKINS*

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Twenty-three goat and twenty-seven sheep skins inflicted with fire-mark were examined and the conditions of the lesions formed were studied in detail, in raw skins and during their processing. Firing could be classified into different types depending upon the objects used. Firing-mark was noted in dlfferent locations of the skins and a correlation has been attempted between the location of firing and the chronic ailment which is expected to be cured by such firing-mark. Histopathology of the affected areas revealed an increase in collagen fibres, orientation in skin structure and keratotic changes in the epidermis. Physico-chemical properties of skin and physical properties of raw and tanned fibres and of leather in the affected areas were found to be modified to a certain extent. A considerable portion of the leather is found to be severely damaged due to the fire-mark, which is more similar to the fire brand marks used for the purpose of identification.

Introduction

Firing on animal skin had been used in olden days as a specific method of treatment (Therapeutic cautery) in lower leg pathology (below the carpus and fetlock) amonst equine practice[1,2]. Such kind of firing was used for conditions which might be classfied as periostitis and osteoperiostitis and was indicated in conditions such as ring bone, splint, spavin, exostoses of the carpus and fetlock joint etc. The object of firing was to create artificially an acute inflammation which resolved the inflammatory process. Conner[2] reported various types of firing such as (i) objective firing, (ii) superficial line firing, (iii) penetrating point firing, (iv) superficial point firing and (v) needle point firing. However, in developed countries firing has been replaced by more conservative methods of therapy.

Unfortunately firing on animal skin with red hot iron has become a crude practice amongst Indian villagers. Fire-mark degrades the quality of raw skin and their leather making property, The incidence[3] of such fire-mark amongst goat and sheep skins is found to be significantly high accounting for a great national economic loss. Such fire-mark is not made for the purpose of identification of the animals as is the case with fire-branding of cattle with red hot iron.

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thickening from the adjacent unaffected area. In certain cases the grain was peeled off.

In case of line firing and wire firing the grain might be peeled off. But in most of the cases where there was no peeling off of the grain, the fire-mark appeared like that of raised areas resembling the scar of a healed sutured wound as a result of an operation on the living skin.

Histological changes in fire-mark inflicted areas of skin

There was marked collagenisation with dense collagen fibre bundles in the region of the firing. The collagen fibre bundles close to the epidermis were oriented horizontally (Fig. 6) with loss of characteristic angle of weave pattern. Fibre bundles closer to the flesh showed low angle of weave.

Marked parakeratosis and hyperkeratosis were observed in the epidermal region of the fire-marked areas.

Development of 'Keloid' like structure (cutaneous horns) was noted on the line of firing (in the region of the back bone anywhere between the neck and the butt) which structurally showed distension of superficial lymphatic vessels (Fig. 7).

Water uptake during alkaline swelling of skin

Alkaline swelling of the affected and unaffected areas of goat and sheep skins were determined. Average values obtained from two seperate swelling tests for both goat and sheep skins are presented in Table 1.

It is quite apparent from the above data that water uptake by fire-mark affected areas of skin is comparatively higher than that of adjacent control samples.

Amino acid composition of fire-mark affected area of skin

The amino acid compositions of affected and unaffected areas of skin are presented in Table 2.

TABLE 1

Water uptake* by fire-mark inflicted areas of raw goat and sheep skins

Hours of soak in 10 per cent lime solution	*Goat skin*		*Sheep skin*	
	Control	*Experimental*	*Control*	*Experimental*
24	356.64	404.78	488.3	739.7
48	452.90	439.84	508.7	790.9
72	460.56	401.99	519.6	852.5
96	504.53	647.88	533.5	936.4

* Percent increase in weight on moisture free basis.

TABLE 2

Amino acid composition of fire-mark affected portion of goat skin as compared with the adjacent control

Amino acid	*Control (Residues per 1000 residues)*	*Experimental (Residues per 1000 residues)*
Hydroxyproline	91.1	76.2
Aspartic acid	48.7	44.6
Threonine	23.3	26.8
Serine	41.3	34.0
Proline	136.7	111.1
Glycine	278.6	357.7
Alanine	96.4	113.5
Valine	21.2	22.7
Methionine	2.1	absent
Isoleucine	18.0	15.4
Leucine	37.0	33.3
Tyrosine	9.5	2.4
Phenyl alanine	18.0	14.0
Hydroxylysine	3.2	2.4
Lysine	33.0	24.3
Histidine	4.2	3.2
Arginine	44.5	37.3
Lysine - hydroxylysine ratio	10.3	10.1
Proline - hydroxyproline ratio	1.5	1.5

TABLE 4

Physical properties of chrome tanned leathers made out of goat and sheep skins

	Tensile strength (Kg/sq cm.)		*Elongation (%)*		*Stitch tear resistance (kg/cm thickness)*		*Tongue tear resistance (kg/cm thickness)*		*Shrinkage Temperature (°C)*	
	Control	*Experimental*	*Control*	*Experimental*	*Control*	*Experimental*	*Control*	*Experimental*	*Control*	*Experimental*
					Goat skins (5 Nos.)					
Maximum	362.0	351.3	67.5	67.5	129.0	122.9	20.6	31.2	123.0	120.0
Minimum	109.5	66.8	37.5	30.0	25.5	57.7	8.5	17.0	118.0	114.0
Average	190.4	198.0	51.5	43.0	91.1	93.2	15.6	21.8	120.4	116.6
					Sheep skins (4 Nos.)					
Maximum	262.2	311.6	70.0	75.0	106.7	90.7	34.7	18.9	121.0	119.0
Minimum	126.0	94.5	25.0	20.0	60.5	61.9	18.1	11.3	116.0	112.0
Average	174.2	186.9	50.0	36.9	85.3	80 0	22.8	14.2	119.0	116.25

TABLE 5

SATRA grain crack values for goat and sheep chrome crust.

Skin No.	*Type of skin*	*Control*		*Experimental*		*Grain crack resistance (kg/cm thickness)*		*Bursting resistance (kg/cm thickness)*	
		Distension at grain crack (mm)	*Distension at bursting (mm)*	*Distension at grain crack (mm)*	*Distension at bursting (mm)*	*Control*	*Experimental*	*Control*	*Experimental*
CCXIX	Sheep	8.2	8.9	5.9	9.8	256.8	111.8	304.1	452.9
CLXII Sample (1)	Goat	7.3	9.6	7.1	8.3	217.9	255.5	397.4	277.7
Sample (2)	Goat	8 4	9.4	7.7	8.4	287.5	288.9	400.0	500.0
CCLXXXX Sample (1)	Goat	7.8	8.9	6.5	6.8	224.2	183.4	310.4	205.6
Sample (2)	Goat	6.2	8.5	7.5	7.5	181.8	275.0	350.6	262.5
CLIX	Goat	8.1	10.2	8.9	10.0	263.1	275.0	513.1	362.5
CCXXXIX	Sheep	10 6	11.3	12.9	13.6	227.2	141.61	281.8	183.3
CCXXXXVIII	Sheep	10.3	12.41	10.3	11.1	109.0	300.0	209.0	330.0
CCXXXIV	Sheep	10.4	11.9	10.2	12.5	110.0	163.6	180.0	209.0
CCXVIII	Sheep	9.2	12.9	10.3	12.6	150.0	141.6	290.0	166.6
IV*	Goat	7.2	8.3	5.1	7.8	207.4	108.2	229.6	133.7

* Semi chrome tanned dyed crust and all the others are chrome tanned leather.

Grain crack values :

6.0 mm and below : **Sub-standard.**
8.0 mm and above : **Very good.**
7.0 mm : **Satisfactory.**

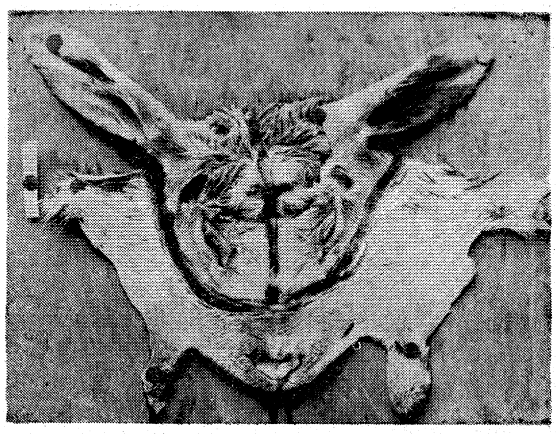
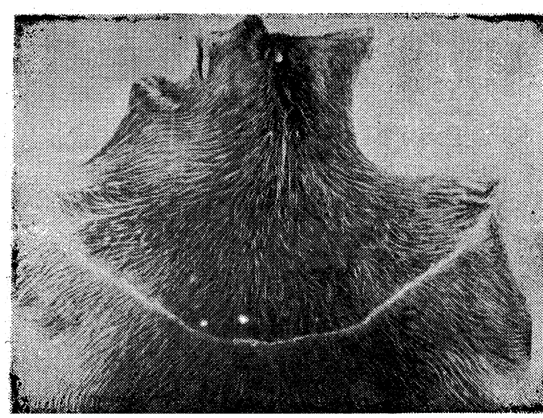


Fig. 3. Line fire-mark on the head skin piece of a sheep

Fig. 4. Wire fire-mark in the shoulder region of a goat skin.



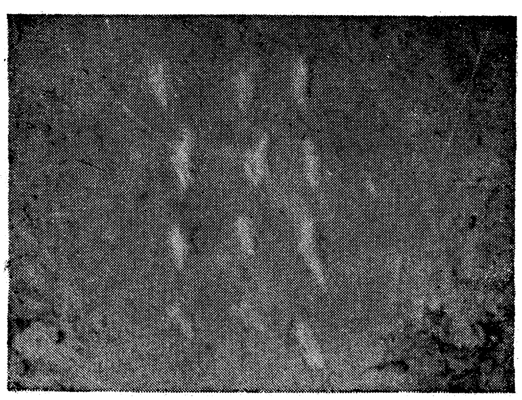


Fig. 5. Point fire-mark on the flesh side of a sheep skin.

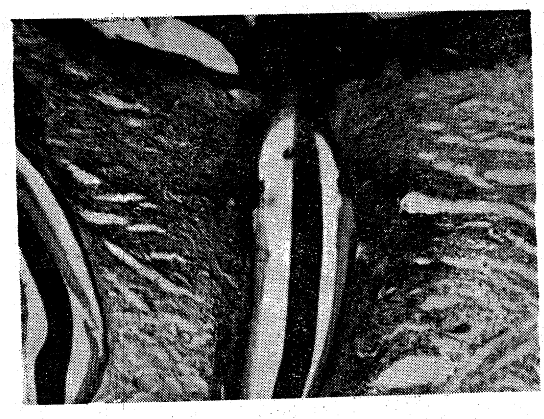


Fig. 6. Section through the fire-mark inflicted area of goat skin showing horizontal orientation of the collagen fibre bundles.

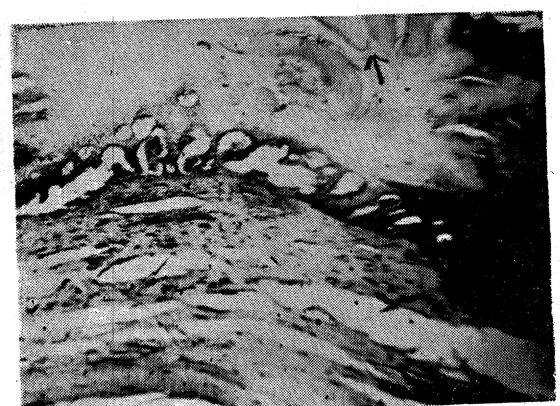


Fig. 7. Section through 'keloid' like structure (cutaneous horns) due to fire-mark on goat skin, showing distension of superficial lymphatic vessels

Fig. 8. Larva of **Oestrus ovis** seen in one of the horn core of goat, causing *'FALSE GID'* and one of the causes for inflicting fire-mark.

Fig. 9. An unilocular cyst **Coenurus cerebralis** responsible for *'GID'* and one of the causes for inflicting fire-mark

the rumen with gas), firing is usually done on the sides of the abdomen (belly region). On animals suffering from 'chronic diarrhoea' the areas selected for firing would be the butt region. On occasions like the 'convulsions due to early stages of mild enterotoxaemia' firing is being done on various parts of the body. For the dislocation of the joints and fracture of bones the fire-marks are usually applied on the regions of the shoulder or hip joints.

It is also common practice for the flock-men to inflict fire-marks over the head of the animals (goat and sheep) which show nodding of the head, and circling gait as symptoms due to 'false gid' and 'gid'. As the skins over the head does not come under the purview of leather making, the practice of firing on the head (Fig. 3) does not have much significance.

In raw skin, the damage due to fire-mark is apparent only on the flesh side except in case of plate firing, where it is seen on the grain side too. After liming, the damage is clearly visible on both the grain and flesh side and it remains distinctly visible even after tanning.

Histopathological study reveals that dermal collagenisation takes place in the affected area but the collagen fibre bundles are organised rather horizontally. Parakeratosis and hyperkeratosis of the epidermis have been observed in the regions of fire-mark. Such changes in structural characteristics are however expected when the skin surface is affected by firing.

Certain physico-chemical changes take place in the skin due to firing which is apparent from the increased water uptake during alkaline swelling. The amino acid composition of collagen fibres is also found to be affected to a certain extent due to fire-mark but the lysine-hydroxylsine ratio and proline-hydroxyproline ratio are very little affected or not affected at all.

MBL and elongation values for fire-mark affected vegetable tanned collagen fibres appear to be higher and lower respectively than from their corresponding control, while both these value are appreciably low in affected raw collagen fibres. It is apparent from Table 4 that physical properties may vary from leather to leather and also depending upon the degree of intensity of fire-mark ie., whether it is superficial or deeply inflicted. SATRA grain crack values (Table 5) of all the affected portions of chrome tanned leather, except two, appear to be more than 6 mm and hence they prove to be satisfactory or even very good for fabrication. Depending upon the intensity of damage, certain leathers may be considered unsuitable for fabrication. However, variation in magnitude of grain crack resistance and bursting resistance depends upon the extent of fibrosis consequent to the healing up of the wound caused due to fire-mark.

It may be noted that a considerable portion of the skin may be rendered useless due to the firing. About 14.77 percent of area in goat skin and 5.07 per cent of area in sheep skin are found to be damaged; but this variation between goat and sheep skins may largely depend upon the type of firing used.

In order to overcome this defect, farmers are to be appraised of the national economic loss caused by firing and they are to be convinced about the alternative veterinary preventive methods available for such chronic ailments.

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